6.4.7 Respirator Donning Procedure

1. Loosen harness strap adjustments.

2. Put chin in facepiece and draw back on adjustment straps evenly (i.e., top two straps, then bottom two straps, and center top strap last).

   a. Harness union should be centered on the back of head

   b. Unevenly adjusted straps will create a leak. They are also very uncomfortable.

   c. Straps should be drawn back no more than necessary

3. Check for leaks and/or proper facial seal.

   a. Cover cartridge air ports with palm of hands and attempt to pull air through the inhalation ports. Mask should collapse slightly on face.

   b. Count to eight while holding your breath. Pressure inside of facepiece should be maintained for the duration of the count.

   c. If pressure is not maintained, check and/or adjust straps. (NOTE: make sure that palms are blocking all of the cartridge air ports. This could be the source of leakage.)

   d. Check exhalation valve by exhausting air through the valve. (NOTE: Should detect some resistance but facial seal should not be broken.)

6.4.8 Cleaning of Respirators

Respirators should be cleaned after each use, see Appendix 6-II.

6.4.9 Respirator Fit-Testing

6.4.9.1

OSHA regulations (29CFR Part 1910.134) require that each person who wears a respirator shall have it properly fitted, test the facepiece for face seal, and wear it in a test atmosphere. In order to wear a respirator, the person must go through a fit test to determine whether the person can obtain a satisfactory fit with a "negative pressure" air-purifying respirator. The results of the fit test will be used to select the specific type, make, and model of "negative pressure" air-purifying respirator for use by the wearer.

The following policies should be adhered to in the fitting and use of the respirators:

1. A person must have passed the fit test in order to use any NIOSH/MSHA approved respirators.

2. If it is found that a person cannot obtain a good respirator-to-face seal because of facial or medical characteristics, the person should not use and/or enter an atmosphere that will require the use of a respirator.

3. Facial hair such as beards, sideburns, or certain mustaches which may interfere with the fit test are not allowable.

4. Persons requiring corrective lenses shall be provided with specially mounted lenses inside the full-face mask. Under no circumstances will contact lenses and/or glasses be worn while using full-face respirators.

5. Although fit testing for positive pressure SCBA's is not required as described in ANSI Z88.2 (1980), a less than acceptable respirator-to-face seal will increase the use of air via leakage and therefore reduce effective breathing time. Such leaks may pose a hazard to the user if sufficient air supply is not available to reach an uncontaminated air supply.

6. A person may only use the specific make(s) and model(s) of full-face, air-purifying respirators for which the person has obtained a satisfactory fit via the qualitative fit-testing procedures. Under no circumstances shall a person be allowed to use any make or model respirator not previously fit tested or having failed a fit-test period.

6.4.9.2

Fit testing by use of a two-stage, cross-checking procedure provides the necessary quality assurance that the user of an air-purifying, cartridge/canister respirator is properly fitted and has a good facepiece-to-face seal.

Stage I

1. Negative Pressure-Sealing Checks for Air-Purifying Respirators

   The wearer can perform this test by himself or herself in the field or office after donning the air-purifying respirator. It consists of closing off the inlet of the cartridge(s) to prevent the passage of air. This test is performed by closing off the inlet opening of the respiratory cartridge(s) by covering with the palm of the hand(s) so that it will not allow the passage of

air, inhaling gently, and holding the breath for at least ten seconds. If a facepiece collapses slightly and no inward leakage of air into the facepiece is detected, it can be reasonably assumed that the fit of the respirator to the wearer is satisfactory.

This test is made only as a gross determination of fit when the respirator is to be used in relatively toxic atmospheres. Nonetheless, this test shall be used just prior to entering any toxic atmosphere.

2. Positive Pressure-Sealing Check for Air-Purifying Respirators

This test is very much like the negative pressure-sealing check. This test is preferred after donning the air-purifying respirator which contains an exhalation and inhalation valve. The test is conducted by closing off the exhalation valve and exhaling gently. The fit of a respirator equipped with a facepiece is considered to be satisfactory if a slight positive pressure can be built up inside the face piece for at least ten seconds without detection of any outward leakage of air between the sealing surface of the facepiece and the respirator wearer's face.

This test is also to be used only as a gross determination of fit when the respirator is to be used in relatively toxic atmospheres. This test shall be used just prior to entering any toxic atmosphere.

NOTE: Both the positive and negative pressure-sealing checks can be used on the MSA Model 401 air mask to determine the gross fit characteristics.

Stage II

Introduction

All users or potential users of demand-type respiratory protection devices should be fit tested to ensure a proper facepiece-to-face seal. Either isoamyl acetate or irritant smoke should be used with one of the four methods described below. A selection of respirators should be tested, with users allowed to choose the most comfortable from those that fit satisfactorily.

Methods

1. Method No. 1 - Swab or Brush (Organic Vapors)

Use only facepieces equipped with organic vapor cartridges.

Perform the test in area with no noticeable air movement.

Saturate a tissue, cloth, or brush with isoamyl acetate.

Prior to testing, expose subject to a very low concentration of isoamyl acetate to assure that he/she can detect the odor.

After subject dons the respirator, tester visually inspects facepiece-to-face seal. If seal obviously leaks, test ends and mask is recorded as unsatisfactory. If subject is uncomfortable, test ends.

Move saturated material slowly around entire sealing surface of the respirator at a distance of 3 to 6 inches. Perform first with test subject sedentary, then with subject moving head and face (i.e., talking, moving head side to side and up and down). End test if any leakage occurs.

If the subject detects the odor during fitting, record that respirator as unsatisfactory, remove it from the subject, and visually inspect the facepiece-to-face seal. If any doubt exists about the respirator or cartridges, test a duplicate to assure that the leakage was due to facepiece-to-face seal.

2. Method No. 2 - Around Seal (Particulates)

Use respirators equipped with high-efficiency filters.

Perform test in area with no noticeable air movement.

Break both ends of an MSA ventilation smoke tube. Insert one end into the tube connected to the positive-pressure end of a two-way aspirator bulb and cover the other end with 1- to 2-inch length of Tygon, surgical, or rubber tubing. Squeeze the aspirator bulb to generate the test aerosol.

After subject dons the respirator, tester visually inspects facepiece-to-face seal. If seal obviously leaks, test ends and mask is recorded as unsatisfactory. If subject is uncomfortable, test ends.

Direct the smoke around entire sealing surface of the respirator at a distance of 3 to 6 inches. Instruct subject to breathe shallowly during initial test around surface and normally thereafter if no leakage is detected. If a half-mask is being tested, instruct subject to close his/her eyes for the duration of the test. Perform the test first with subject sedentary, then with subject moving head and face (i.e., talking, moving head side to side and up and down). End test if

any leakage occurs.

If the subject detects the odor during fitting, record that respirator as unsatisfactory, remove it from the subject, and visually inspect the sealing surface. If any doubt exists about the respirator or cartridges, test a duplicate to assure that the leakage was due to the facepiece-to-face seal.

3. Method No. 3 - Enclosure in Plastic Bag (Organic Vapors)

Use facepieces equipped with organic vapor cartridges.

Saturate a tissue or cloth with isoamyl acetate and suspend it inside the top of a plastic garbage bag or harvard hood.

Prior to testing, expose subject to a very low concentration of the isoamyl acetate to assure that he/she can dtect the odor.

After subject dons the respirator, tester visually inspects facepiece-to-face seal. If seal obviously leaks, test ends and mask is recorded as unsatisfactory. If subject is uncomfortable, test ends.

Instruct subject to put his/her head into the bag or hood and breathe normally during a short (30-60 seconds) sedentary period. If no leakage is detected, instruct the subject to perform various exercises simulating, as nearly as possible, work conditions (i.e., talking, running in place, head movements, bending over). End test if any leakage occurs.

If the subject detects the odor during fitting, record that respirator as unsatisfactory, remove it from the subject, and visually inspect the sealing surface. If any doubt exists about the respirator or cartridges, test a duplicate to assure that leakage was due to the facepiece-to-face seal.

4. Method No. 4 - Enclosure in Plastic Bag (Particulates)

Use respirators equipped with high-efficiency filters.

Break both ends of an MSA ventilation smoke tube. Insert one end into the tube connected to the positive-pressure end of a two-way aspirator bulb and cover the end with 1- to 2-inch length of Tygon, surgical, or rubber tubing. Squeeze the aspirator bulb to generate the test aerosol.

After subject dons the respirator, tester visualy inspects facepiece-to-face seal. If seal obviously leaks, test ends and mask is recorded as unsatisfactory.

If subject is uncomfortable, test ends.

Generate smoke into the input of the harvard hood or a hole punched in the top of the closed plastic bag until smoke can be visually detected throughout the bag or hood.

Instruct subject to put his/her head into the bag or hood and breathe shallowly during a short (30-60 seconds) sedentary period. If a half-mask is being tested, instruct subject to close his/her eyes befor entering and keep them closed until exiting. If no leakage is detected during sedentary period, instruct subject to erform various exercises simulating, as nearly as possible, work conditions (i.e., talking, running in place, head movements, bending over) while breathing normally. End test if any leakage occurs.

If the subject detects the odor during fitting, record that respirator as unsatisfactory, remove it from the subject, and visually inspect the sealing surface. If any doubt exists about the respirator or cartridges, test a duplicate to assure that leakage was due to the facepiece-to-face seal.

6.5 SELF-CONTAINED BREATHING APPARATUS

6.5.1 Introduction

Respiratory apparatus must frequently be used during response to hazardous materials incidents. If the contaminant in unknown or is known but the concentration is too high to use air-purifying respirators, then an atmosphere supplying respirator is required. The self-contained breathing apparatus (SCBA) is generally used because it allows the wearer to work without being confined by a hose or airline.

The wearer of the SCBA depends on it to supply clean breathing air. If the wearer is not properly trained to wear the SCBA or it is not properly cared for, then it may fail to provide the protection expected.

The user should be completely familiar with the SCBA being worn. Check-out procedures have been developed for inspecting an SCBA prior to use, allowing the user to recognize potential problems. An individual who checks out the unit is more comfortable and confident wearing it.

There are two types of apparatus: closed-circuit, which uses compressed oxygen, and open-circuit, which uses compressed air. SCBA's may operate in one of two modes, demand or pressure-demand. The length of time an SCBA operates is based on the air supply. The units available operate from 5 minutes to over 4 hours.

Both open- and closed-circuit SCBA's will be discussed and the modes of operation explained. The bulk of the discussion deals with open-circuit pressure-demand SCBA's which are most widely used because they offer more protection.

6.5.2 Modes of Operation

6.5.2.1 Demand

In the demand mode, a negative pressures is created inside the facepiece-to-face and breathing tubes when the wearer inhales (Table 3.1). This negative pressure draws down a diaphragm in the regulator of an SCBA. The diaphragm depresses and opens the admission valves, allowing air to be inhaled. As long as the negative pressure remains, air flows to the facepiece.

The problem with demand operation is that the wearer can inhale contaminated air through any gaps in the facepiece-to-face sealing surface. Hence, demand apparatus is assigned a Protection Factor of only 100, the same as for a full-face air-purifying respirator.

Exhibit 6.15
Pressure Inside Facepiece of SCBA Relative to Ambient Pressure Outside

	Demand	Pressure Demand
Inhalation	-	+
Exhalation	+	+
Static (between breaths)	same	+

6.5.2.2 Pressure-Demand

An SCBA operating in the pressure-demand mode maintains a positive pressure inside the facepiece at all times. The system is designed so that the admission valve remains open until enough pressure is built up to close it. The pressure builds up because air is prevented from leaving the system until the wearer exhales. Less pressure is required to close the admission valve than is required to open the spring-loaded exhalation valve.

At all times, the pressure in the facepiece is greater than the ambient pressure outside the facepiece (Exhibit 6.15). If any leakage occurs, it is outward from the facepiece. Because of this, the pressure-demand SCBA has been assigned a Protection Factor of 10,000.

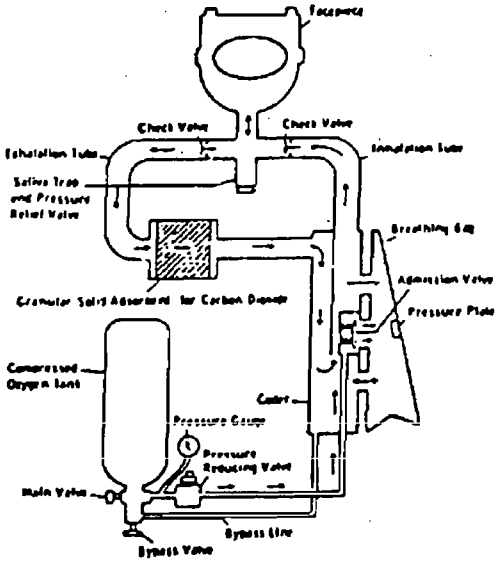
6.5.3 Types of Apparatus

6.5.3.1 Close-Circuit

The closed-circuit SCBA, commonly called the rebreather, was developed especially for oxygen-deficient situations (Exhibit 6.16). Because it recycles exhaled breath and carries only a small oxygen supply, the service time can be considerably greater than an open-circuit device, which must carry all of its breathing air.

The air for breathing is mixed in a flexible breathing bag. This air is inhaled, deflating the breathing bag. The deflation depresses the admission valve, allowing the oxygen to enter the bag. There it mixes with exhaled breath, from which carbon dioxide has just been removed.

Exhibit 6.16



Most rebreathers operate in the demand mode. Several rebreathers are designed to provide a positive pressure in the facepiece. The approval schedule 13F under 30 CFR Part 11 for closed-circuit SCBA makes no provisions for testing "demand" or "pressure-demand" rebreathers. The approval schedule was set up to certify only rebreathers that happen to operate in the pressure-demand mode can be approved strictly as closed-circuit apparatus. Since regulations make no distinction, and selection is based on approval criteria, rebreathers designed to maintain a positive pressure can only be considered as a demand-type apparatus.

Rebreathers use either compressed oxygen or liquid oxygen. To assure the quality of the air to be breathed, the oxygen must be at least medical grade breathing air which meets the requirements set by the "U.S. Pharmacopeia".

7.6 TYPES OF PERSONAL PROTECTIVE EQUIPMENT

The selection of appropriate gear is based on the level of protection needed. The following gear forms the basis of the protective clothing scheme.

1. Head Protection - Hard hats must meet ANSI Z89.1 - 1969 specifications for puncture resistance. They come in several different shapes as well as colors and composition. Selection is based on personal preference. Some manufacturers have adapters so ear protectors and face shields may be attached. Most allow for liners for use in cold weather.

   a. Hard hats. Regulated by 29 CFR 1910.135; specifed in ANSI Z89.1, Safety Requirements for Industrial Head Protection (1969).

2. Face Shield - When there is a possibility of splashing to occur, a face shield should be worn (except with an SCBA). The shield should cover the entire face and the chemical cartridges on the respirator. The shield should fit firmly against the brim of the hat in order to prevent any liquid from running down the face in the event of a splash.

3. Safety Goggles - Safety goggles should be used when eye protection is needed, such as when a half-mask respirator is being used. Safety goggles are good against particulants, but may not be adequate for some vapors.

4. Safety Glasses - When visual correction is needed or when eye protection is desired, only approved safety glasses should be used on a site.

   a. Face shields and safety glasses. Regulated by 29 CFR 1910.133(a); specified in ANSI Z87.1, Eye and Face Protection (1968). Glasses must be approved for industrial use. Glasses used inside the face piece of a respirator, should, but are not required to, meet those standards.

5. Hearing Protectors - Hearing protectors are required in areas where the TWA is above 90 dBA. It is recommended that they be provided to any employee who is exposed to noise and requests them. Either ear plugs or ear muffs meeting ANSI specifications for hearing protectors may be used, providing they meet the necessary attenuation requirements.

6. Body Protection - Whole body protection ranges from cotton coveralls to totally encapsulating suits. As previously discussed, an evaluation must be made to determine if the site contains chemicals which by their nature or concentration create a hazard to the skin.

Each job must be assessed to determine the degree of protection necessary. For example, a person operating a drill rig may need only cotton or Tyvek coveralls. Another - opening drums - may require PVC overalls with a butyl rubber apron. Like gloves, body protection come in a variety of materials. Permeation data for gloves are applicable to body protection made of the same material. Unlike gloves, coveralls have seams, zippers, or buttons which pose penetration problems. When selecting coveralls, a person should look for double stitched overlapping seams; buttons only on splash suits not meant to protect from vapors; and zippers which are covered by another layer of protective material. If the suit becomes ripped, its barrier properties are lost. Damaged suits should be disposed of to prevent inadvertent use.

a. Overall body protection (.e.g., fully encapsulating suits, aprons). Not specifically regulated.

7. Hand Protection - As previously discussed, there are several different materials with which gloves are made. During the discussion, the problems associated with material selection was addressed. When making glove selection, the chemical(s), type of material, thickness and construction must be kept in mind. This includes the length and type of cuffs. The use of disposable gloves should be encouraged when practical, unless cost and chemical hazards prohibit it.

a. Hand protection. Not specifically regulated.

8. Foot Protection - In many cases, the part of the body which has the closest contact with the site is the feet. Minimum standards require the use of steel toes and shanks. This rule applies to all foot protection, from leather work boots to "rubber" boots. Selection of rubber boots should be similar to gloves. The chemicals should be identified, concentration, physical state, length of exposure and terrain must be considered before making selection. Because boots are so hard to decontaminate, booties that fit over the regular boots should be worn. When they start to deteriorate, they can be discarded. Many are designed with a reinforced sole so they do not twist sideways and provide for longer use. They come in various thicknesses and materials.

a. Foot protection. Regulated by 29 CFR 1910.136; specified in ANSI Z41.1, Safety Toe Footwear (1967).

7.7 LEVELS OF PROTECTIVE CLOTHING

7.7.1 Introduction

Personnel must wear protective equipment when response activities involve known or suspected atmospheric contamination, when vapors, gases, or particulates may be generated, or when direct contact with skin-affecting substances may occur. Respirators can protect the lungs, gastrointestinal tract, and the eyes against air toxicants. Chemical resistant clothing can protect the skin from contact with skin-destructive and absorbable chemicals. Good personal hygiene limits or prevents ingestion of material.

The level of protection selected should be based primarily on--

1. Type(s) and measured concentration(s) of the chemical substance(s) in the ambient atmosphere and its toxicity.

2. Potential or measured exposure to substances in the air, splashes of liquids, or other direct contact with material due to work being performed.

In situations where the type(s) of chemicals(s), concentration(s), and possibilities of contact are not known, the appropriate level of protection must be selected on the basis of professional experience and judgment until the hazards can be better characterized.

While personnel protective equipment reduces the potential forcontact with harmful substances, ensuring the health and safety of response personnel requires, in addition, safe work practices, decontamination, site entry protocols, and other safety considerations. Together, these protocols establish a combined approach for reducing potential harm to workers.

An overall protective clothing scheme providing various levels of protection is a convenient means of selecting protective clothing. Levels A, B, C, and D are used to denote degrees of respiratory protection; Level A also specifies protective clothing (i.e., fully encapsulating chemical-resistant suits). In order to distinguish respiratory protection levels from protective clothing levels below the fully encapsulating suit, this guide will discuss protective clothing in terms of Levels 1, 2, and 3. Most hazardous waste sites require a variety of levels of protection. A generalization which usually holds true is that on a given site respiratory protection is "area specific" while protective clothing is "task specific". There are occasions - sampling an unknown liquid - where, as a precaution, an SCBA might be worn even though instruments show the area to be "safe". In general, however, respiratory protection levels will be designated for a site on the basis of air